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(54) **TRANSMISSION POWER CONTROL APPARATUS OF BASE STATION OF MOBILE COMMUNICATION NETWORK**

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(58) **Field of Search** 455/561, 562.1, 455/127.1, 127.2, 126, 522

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(57) **ABSTRACT**

A transmission power control apparatus of a base station of a mobile communication network including: an up-converter for converting a received intermediate frequency (IF) signal to a radio frequency (RF) signal and outputting it; a high power amplifier for amplifying the power of the signal outputted from the up-converter; a coupling unit for receiving the signal from the high power amplifier, extracting only a signal of a necessary frequency band and outputting the extracted signal to an antenna; an attenuator for receiving the signal from the coupling unit, controlling the gain of the signal and outputting it to the up-converter; a comparing unit for comparing the gain control signal applied from the up-converter and the gain control signal inputted from an external source and controlling the attenuator; a controlling unit for providing the gain control signal inputted from the external source to the comparing unit; and an automatic gain controller for generating a gain control signal, control a signal gain of the up-converter and providing the gain control signal to the comparing unit. The transmission power control apparatus additionally includes a second tuning function to receive a gain control signal from an external source to play a part in controlling the signal gain of the first voltage variable attenuator **40**.

7 Claims, 2 Drawing Sheets

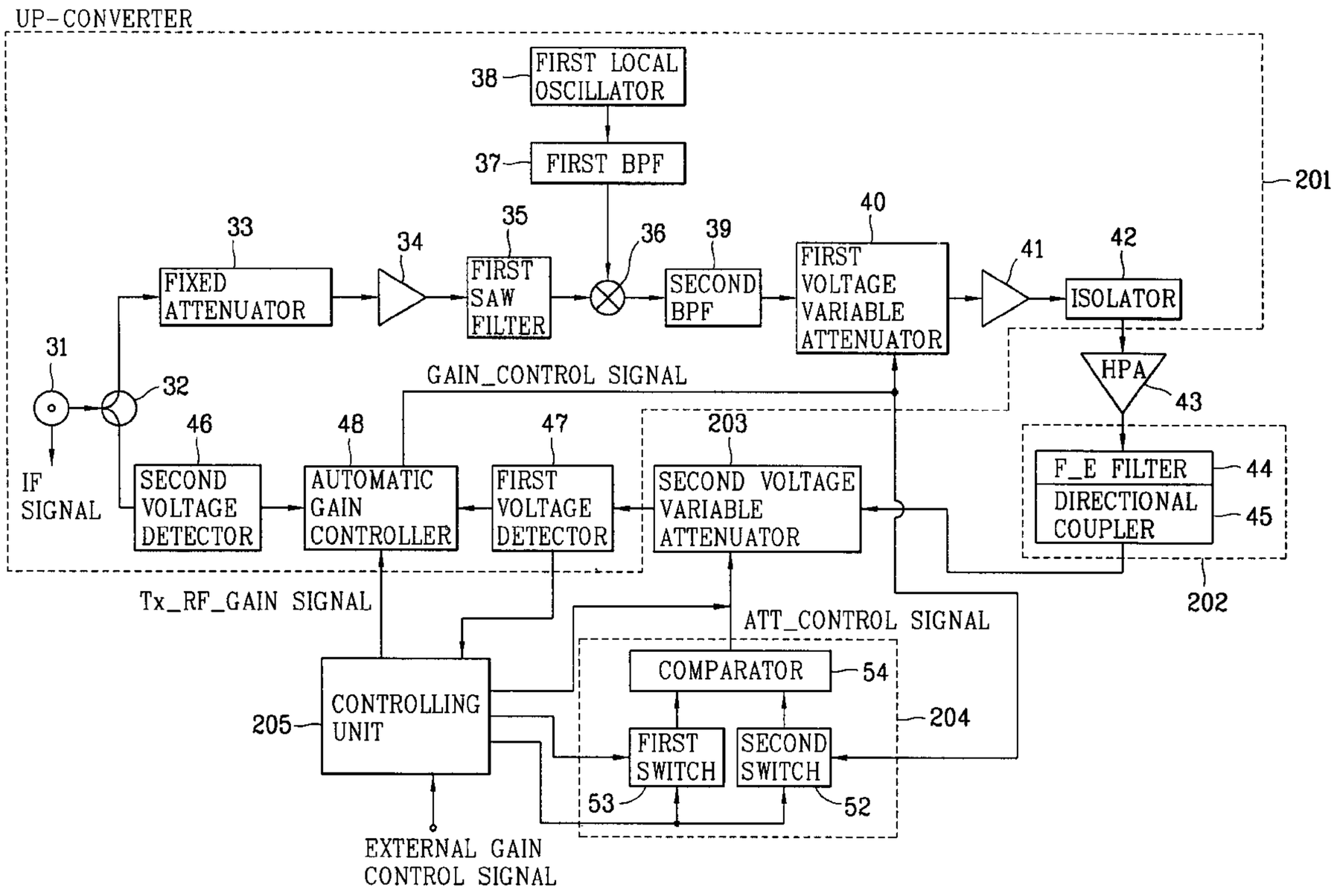


FIG. 1
BACKGROUND ART

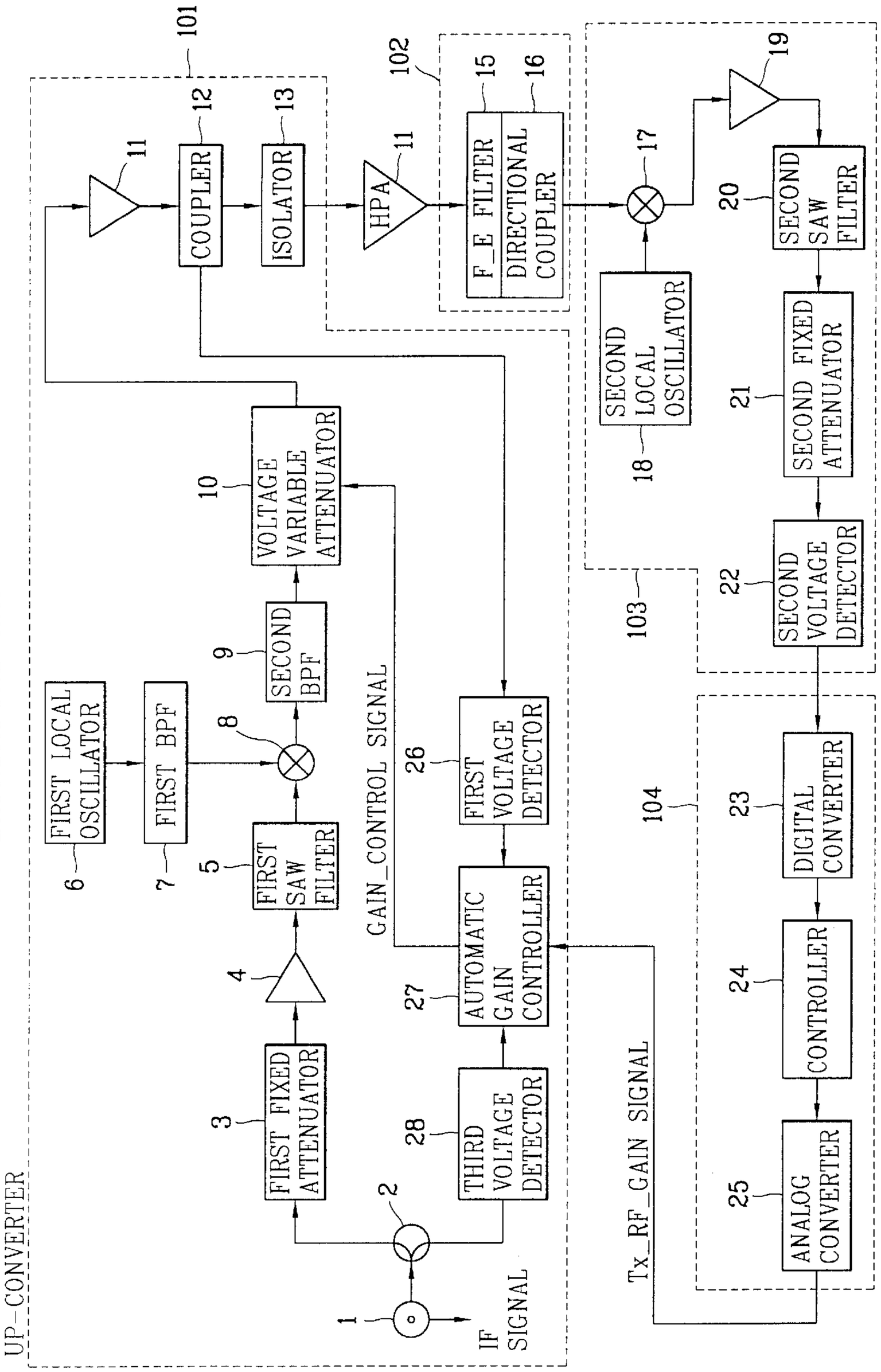
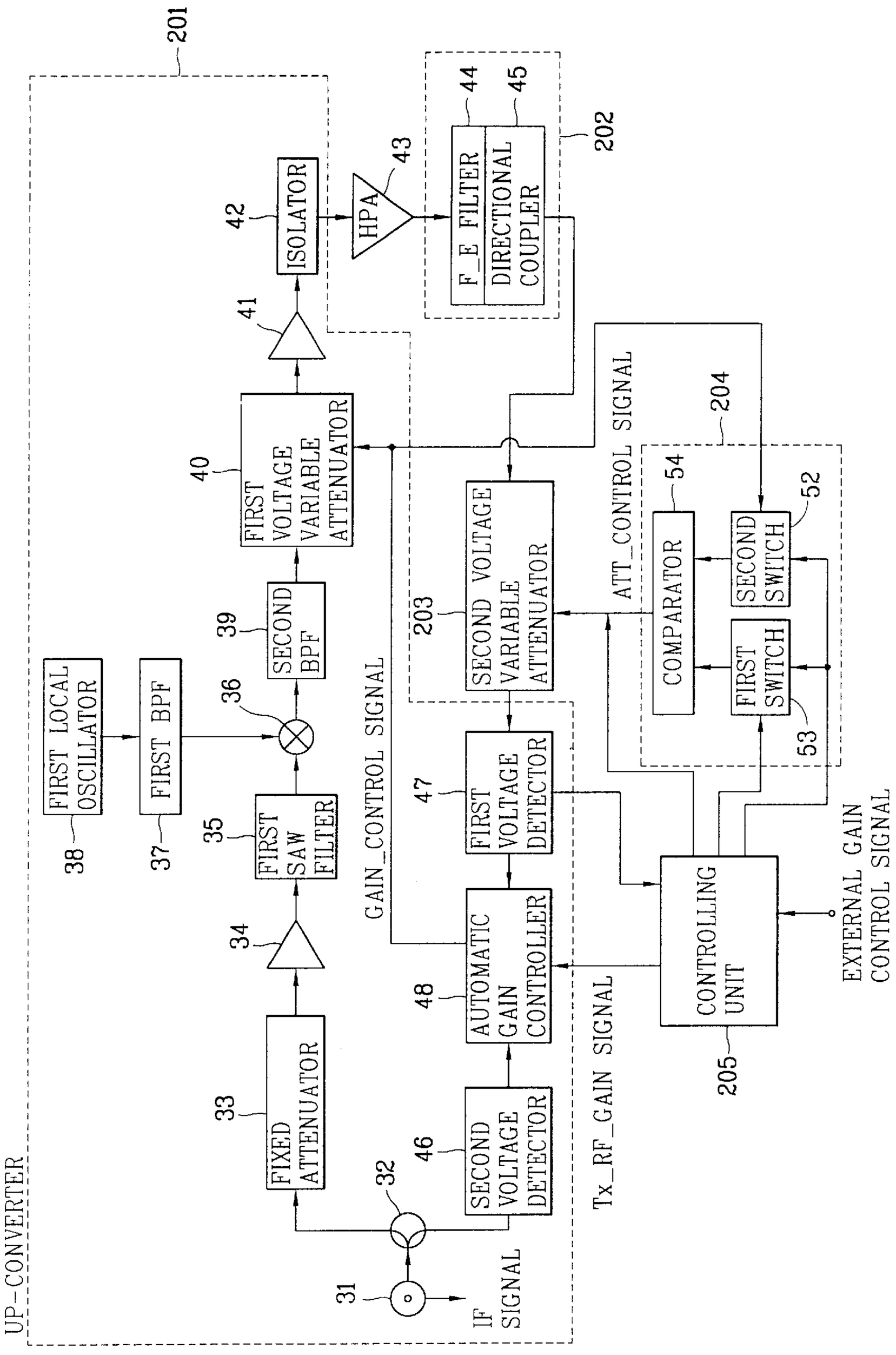


FIG. 2


UP-CONVERTER
201
FIRST LOCAL OSCILLATOR
38
FIRST BPF
37
FIRST SAW FILTER
35
36
SECOND BPF
39
FIRST VOLTAGE VARIABLE ATTENUATOR
40
41
ISOLATOR
42
HPA
43
F_E FILTER
44
DIRECTIONAL COUPLER
45
202
ATT_CONTROL SIGNAL
204
SECOND VOLTAGE VARIABLE ATTENUATOR
203
COMPARATOR
54
SECOND SWITCH
52
FIRST SWITCH
53
FIRST VOLTAGE DETECTOR
47
AUTOMATIC GAIN CONTROLLER
48
GAIN_CONTROL SIGNAL
CONTROLLING UNIT
205
EXTERNAL GAIN CONTROL SIGNAL
Tx_RF_GAIN SIGNAL
FIXED ATTENUATOR
33
34
SECOND VOLTAGE DETECTOR
46
32
31
IF SIGNAL

TRANSMISSION POWER CONTROL APPARATUS OF BASE STATION OF MOBILE COMMUNICATION NETWORK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a base station of a mobile communication network, and more particularly to a transmission power control apparatus of a base station of a mobile communication network.

2. Description of the Background Art

Generally, an up-converter of a transmitter in a base station of a mobile communication network converts an intermediate frequency (IF) signal to a radio frequency (RF) signal and controls the RF signal to have a suitable level of power (strength). For this purpose, the transmitter includes a voltage detecting unit, an automatic gain controller and an attenuator to detect the strength of a signal on the transmission path and generates a control signal to control the gain of the signal.

And, a different voltage detecting unit and a different controller constructed in other circuit board detect the strength of the signal outputted from the up-converter and control the gain of the signal to have the appropriate strength.

FIG. **1** is a schematic block diagram of the transmitter of a base station of a mobile communication network in accordance with a conventional art.

As shown in the drawing, a transmitting apparatus of the mobile communication network in accordance with the conventional art includes an up-converter **101** for converting a received intermediate frequency (IF) signal to an RF signal and controls the gain of the converted RF signal, a high power amplifier (HPA) **14** for amplifying the RF signal outputted from the up-converter **101** to a high power, a coupling unit **102** for receiving the high power RF signal from the HPA **14**, extracting only a required specific frequency band component of the RF signal, and outputting the extracted signal to an antenna and to a voltage detecting unit **103**, the voltage detecting unit **103** for converting the RF signal received from the coupling unit **102** to an IF signal and detecting a voltage level in proportion to the strength of the converted IF signal, and a controlling unit **104** for receiving the detected voltage and outputting a Tx_RF_GAIN signal.

The voltage detecting unit **103** and the controlling unit **104** serve to judge whether the RF signal on the transmission path has the proper strength and monitor it.

The up-converter **101** includes a splitter **2** for splitting an inputted signal to two different paths, fixed attenuators **3** and **21** for attenuating the power (strength) of the received signal; amplifiers **4** and **11** for compensating a loss generated during the process of attenuating a power, SAW filters **5** and **20** for extracting a required signal among signals outputted from the amplifier **4**, a frequency up mixer **8** for converting the IF signal to an RF signal, a local oscillator **6** for generating a single frequency signal and providing it to the frequency up mixer **8**, band pass filters (BPF) **7** and **9** for passing only a specific band signal, a voltage variable attenuator **10** for attenuating the power (strength) of the received signal under the control of the automatic gain controller **27**, a coupler **12** for coupling a received signal to two elements, an isolator **13** for removing a reflection wave causing a transmission distortion, voltage detectors **26** and **28** for detecting a voltage level in proportion to the strength of the inputted signal, and the automatic gain controller **27** for generating a gain control signal for controlling the voltage variable attenuator **10**.

The operation of the transmitter of the mobile communication network base station in accordance with the conventional art constructed as described above will now be explained.

An IF signal **1** inputted to the up-converter **101** is split to two paths by the splitter **2**, and while the IF signal passes the first fixed attenuator **3**, the amplifier **4** and the first SAW filter **5**, a noise is canceled to a degree. And then, the IF signal is converted to an RF signal by the frequency up mixer **8** and the first local oscillator **6** and outputted to the second band pass filter **9**.

As the RF signal passes the second band pass filter **9**, its specific frequency band component is extracted, and the gain of the filtered signal is controlled to be down by the voltage variable attenuator **10** and outputted to the amplifier **11**.

The amplifier **11** amplifies the power-attenuated RF signal to a certain level and outputs it to the isolator **13**, and the isolator **13** removes the reflection wave included in the RF signal to prevent generation of a transmission distortion. The reflection wave-removed RF signal is outputted to the HPA **14**.

The RF signal is amplified by the HPA **14** to have a high power and outputted to the coupling unit **102**, so that an unnecessary frequency component of the RF signal is removed by the front end filter **15** of the coupling unit **102** and outputted back to the antenna, and also coupled by a directional coupler **16** of the coupling unit **102** so as to be outputted to the voltage detecting unit **103**.

In the voltage detecting unit **103**, the RF signal is converted to the IF signal by the second oscillator **18** and the frequency down mixer **17** and outputted to the amplifier **19**. The second local oscillator **18** generates a signal having a single frequency and provides it to the frequency down mixer **17**.

The IF signal is amplified by the amplifier **19** and inputted through the second SAW filter **20** and the second fixed attenuator **21** to the second voltage detector **22**. The second voltage detector **22** detects the voltage of the received IF signal and outputs it to the controlling unit **104**.

In the controlling unit **104**, the voltage level signal (an analog signal) is converted into a digital signal and inputted to the controller **24**. The controller **24** judges whether the RF signal transmitted through the antenna has a proper strength, computes a difference value (Δ) between the voltage detected by the voltage detecting unit **103** and a reference voltage and provides a Tx_RF_GAIN signal corresponding to the difference value (Δ) to the automatic gain controller **27**. The controller **24** holds a Tx_RF_GAIN signal table corresponding to each voltage difference value.

In the up converter **101**, the coupler **12** positioned before the isolator **13** outputs the received RF signal to the first voltage detector **26**. The first voltage detector **26** detects the voltage level of the received RF signal and outputs it to the automatic gain controller **27**. And, the third voltage detector **28** also receives the IF signal split by the splitter **2**, detects the voltage level of the IF signal and outputs it to the automatic gain controller **27**.

Consequently, the automatic gain controller **27** generates the gain control signal by using the voltage inputted from the first voltage detector **26**, the voltage inputted from the third

voltage detector **28** and the Tx_RF_GAIN signal inputted from the controlling unit **104**, and controls the whole outputting of the transmitting apparatus by providing the generated gain control signal to the voltage variable attenuator **10**.

That is, the automatic gain controller **27** generates the gain control signal according to the strength of the RF signal provided from the first voltage detector **26**, or generates the gain control signal according to the Tx_RF_GAIN signal provided from the controlling unit **104**, to control the strength of the RF signal transmitted through the transmission antenna.

The conventional transmission power controlling apparatus of the mobile communication network base station, however, has the following problems.

That is, since the voltage detector, the filter, the local oscillator and the frequency mixer are used redundantly, the production cost of the system is increased.

In addition, the path loss and the deviation due to the allowable error of the elements occurring in the circuit itself which monitors and controls the output signal.

Moreover, the gain control signal may be varied depending on what value a system sets as an initial value when the up-converter is manufactured, and when the base station transmitter is installed, since the calibration is made for the power (strength) of a signal transmitted to the antenna, it is difficult to verify whether the up-converter operates properly without any trouble.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a transmission power control apparatus of a base station of a mobile communication network which does not include any redundant parts, and in which a signal gain of an up-converter can be also adjusted by an external source.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a transmission power control apparatus of a base station of a mobile communication network including: an up-converter for converting a received intermediate frequency (IF) signal to a radio frequency (RF) signal and outputting it; a high power amplifier for amplifying the power of the signal outputted from the up-converter; a coupling unit for receiving the signal from the high power amplifier, extracting only a signal of a necessary frequency band and outputting the extracted signal to an antenna; an attenuator for receiving the signal from the coupling unit, controlling the gain of the signal and outputting it to the up-converter; a comparing unit for comparing the gain control signal applied from the up-converter and the gain control signal inputted from an external source and controlling the attenuator; a controlling unit for providing the gain control signal inputted from the external source to the comparing unit; and an automatic gain controller for generating a gain control signal, control a signal gain of the up-converter and providing the gain control signal to the comparing unit.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

FIG. **1** is a schematic block diagram of transmitting apparatus of a base station of a mobile communication network in accordance with a conventional art; and

FIG. **2** is a schematic block diagram of a transmitting apparatus of a base station of a mobile communication network in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

FIG. **2** is a schematic block diagram of a transmitting apparatus of a base station of a mobile communication network in accordance with the present invention.

As shown in the drawing, the transmitting apparatus of the base station of the mobile communication network includes an up-converter **201** for converting a received IF signal to an RF signal and controls the gain of the RF signal, a high power amplifier (HPA) **43** for amplifying the RF signal outputted from the up-converter **201** to a high power, a coupling unit **202** for receiving the high power RF signal from the HPA **43**, extracting only a signal of a required frequency band and outputting the extracted signal to an antenna and a second voltage variable attenuator **203**, and a controlling unit **205** for providing a gain control signal inputted from an external source to the comparing unit **54** or providing a Tx_RF_GAIN signal to an automatic gain controller **48**.

The up-converter **201** includes a splitter **32** for splitting an inputted signal to two different paths; a fixed attenuator **33** for attenuating the power (strength) of an inputted signal, amplifiers **34** and **41** for compensating the loss generated in the process of attenuating the power of the signal; a SAW filter **35** for extracting only a required signal among signals outputted from the amplifier **34**, a frequency up mixer **36** for converting an IF signal to an RF signal, a local oscillator **38** for generating a single frequency signal and providing it to the frequency up mixer **36**, band pass filters **37** and **39** for passing only a specific band signal, voltage variable attenuators **40** and **203** for attenuating the power (strength) of a received signal under the control of the automatic gain controller **48**, an isolator **42** for removing a reflection wave causing a transmission distortion, voltage detectors **46** and **47** for detecting a voltage level in proportionate to the strength of an inputted signal; and the automatic gain controller **48** for generating a gain control signal to control the voltage variable attenuator **40**.

The operation of the transmission power control apparatus of the base station of the mobile communication network constructed as described above will now be explained.

The IF signal **31** inputted to the up-converter **201** is split to two paths by the splitter **32** and passes the fixed attenuator **33**, the amplifier **34** and the SAW filter **35**, during which a noise thereof is canceled to a degree. And then, the IF signal is converted to an RF signal by the first local oscillator **38** and outputted to the second band pass filter **39**.

As the converted RF signal passes the second band pass filter **39**, a specific band component is extracted by the second band pass filter **39** and its gain is down-adjusted by the first voltage variable attenuator **40** and outputted to the amplifier **41**.

The amplifier **41** amplifies the power-attenuated RF signal to a predetermined level and outputs it to the isolator **42**. The isolator **42** removes the reflection wave included in the inputted RF signal to thereby prevent generation of a transmission distortion. The reflection wave-removed RF signal is outputted to the HPA **43**.

The RF signal is amplified by the HPA **43** to have a high power and outputted to the coupling unit **202**. And then, the unnecessary frequency component of the RF signal is removed by a front end filter **44** of the coupling unit **202** and outputted to the antenna. The RF signal is also coupled by the directional coupler **45** of the coupling unit **202** and outputted to the second voltage variable attenuator **203**.

The second voltage variable attenuator **203** adjusts the power attenuation amount of the inputted RF signal under the control of the comparing unit **204** and outputs the adjusted RF signal to the first voltage detector **47**.

Then, the first voltage detector **47** detects a voltage level of the adjusted RF signal and outputs it to the automatic gain controller **47** and to the controlling unit **205**.

The controlling unit **205** computes a difference value (Δ) between the voltage of the inputted RF signal and an internally set reference voltage and provides a Tx_RF_GAIN signal corresponding to the difference value (Δ) to the automatic gain controller **48**.

The other IF signal split to a different path by the splitter **32** is inputted to the second voltage detector **46**, by which its voltage level is detected. The detected voltage is inputted to the automatic gain controller **48**.

The automatic gain controller **48** generates a gain control signal by using the voltage inputted from the first voltage detector **47**, the voltage inputted from the second voltage detector **48** and the Tx_RF_GAIN signal inputted from the controlling unit **205**, to control the first voltage variable attenuator **40**. The first voltage variable attenuator **40** maintains constantly the strength of the RF signal transmitted through the antenna under the control of the automatic gain controller **48**.

When the gain control signal is inputted to the controlling unit **205** from an external source, the controlling unit **205** turns the switches **52** and **53** of the comparing unit **204**.

As the switches **52** and **53** operate, the gain control signal, which has been provided to the first voltage variable attenuator **40** from the automatic gain controller **48**, is also provided to the comparator **54** through the first switch **52**, and a gain control signal inputted from an external source is inputted through the second switch **53** to the comparator **54**.

The comparator **54** compares the two gain control signals received through the switches **52** and **53** and provides a suitable attenuation control signal to the second voltage variable attenuator **203** so that the gain control signal value of the first switch can be adjusted to the reference signal (the external gain control signal).

Meanwhile, if no external gain control signal is provided, the controlling unit **205** does not operate the switches **52** and **53** of the controlling unit **204** and provides the internally set attenuation control signal to the second voltage variable attenuator **203**.

In other words, the second voltage variable attenuator **203** receives the attenuation control signal from the comparator **54** or from the controlling unit **204** and controls the strength of the RF signal inputted from the coupling unit **202**, and the adjusted RF signal affects the Tx_RF_GAIN signal and even the gain control signal of the automatic gain controller **48**, so that the output signal of the transmitter of the base station of the mobile communication network can be arbitrarily adjusted.

As so far described, the transmission power control apparatus of a base station of a mobile communication network includes a second tuning function to receive a gain control signal from an external source to play a part in controlling the signal gain of the first voltage variable attenuator **40**, in addition to the first tuning function performed by the up-converter within the system without an interference from outside. For the second tuning, the switches **52** and **53**, the comparator **54** and the second voltage variable attenuator **203** are provided.

Also, functions of generating and monitoring the attenuation control signal are provided.

Moreover, by adding the second tuning, an error generated in a portion (the HPA **43**, coupling unit **202** or signal lines between elements) other than the up-converter is compensated, and the transmission signal is more accurately calibrated, so that an optimum signal power can be applied to the antenna.

Furthermore, in the present invention, the circuits (elements) redundantly used unnecessarily in the transmitting apparatus of a base station of the conventional art are excluded or their construction is differently formed. Thus, an expense reduction effect can be obtained.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A transmission power control apparatus of a base station of a mobile communication network comprising:

an up-converter for converting a received intermediate frequency (IF) signal to a radio frequency (RF) signal and outputting it;

a high power amplifier for amplifying the power of the signal outputted from the up-converter;

a coupling unit for receiving the signal from the high power amplifier, extracting only a signal of a necessary frequency band and outputting the extracted signal to an antenna;

an attenuator for receiving the signal from the coupling unit, controlling the gain of the signal and outputting it to the up-converter;

a comparing unit for comparing the gain control signal applied from the up-converter and the gain control signal inputted from an external source and controlling the attenuator;

a controlling unit for providing the gain control signal inputted from the external source to the comparing unit; and

an automatic gain controller for generating a gain control signal, control a signal gain of the up-converter and providing the gain control signal to the comparing unit.

2. The apparatus of claim **1**, wherein the comparing unit comprising:

a switch for receiving the gain control signal generated by the automatic gain controller and a reference gain control signal provided from the controlling unit; and

a comparator for comparing the two gain control signals applied through the switch and controlling the attenuator.

3. The apparatus of claim **1**, wherein the controlling unit operates the switch of the comparing unit when a gain control signal is provided from an external source.

4. The apparatus of claim **1**, wherein the controlling unit does not operate the switch of the comparing unit unless a gain control signal is provided from an external source, and controls the attenuator with an internally set gain control signal.

5. The apparatus of claim **1**, wherein the attenuator is controlled by the controlling unit unless a gain control is not provided from an external source, and is controlled by the comparing unit if a gain control signal is provided from an external source.

6. The apparatus of claim **1**, wherein the up-converter, the attenuator, the automatic gain controller, the comparing unit and the controlling unit perform first tuning to control the gain of the RF signal in the system without an interference from outside and perform second tuning to play a part in controlling the gain of the RF signal by using the gain control signal inputted from an external source.

7. The apparatus of claim **6**, wherein the second tuning is performed to compensate an error generated in a transmission path, that is, the high power amplifier, the coupling unit or the connection signal line between elements, of the other part than the up-converter.

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